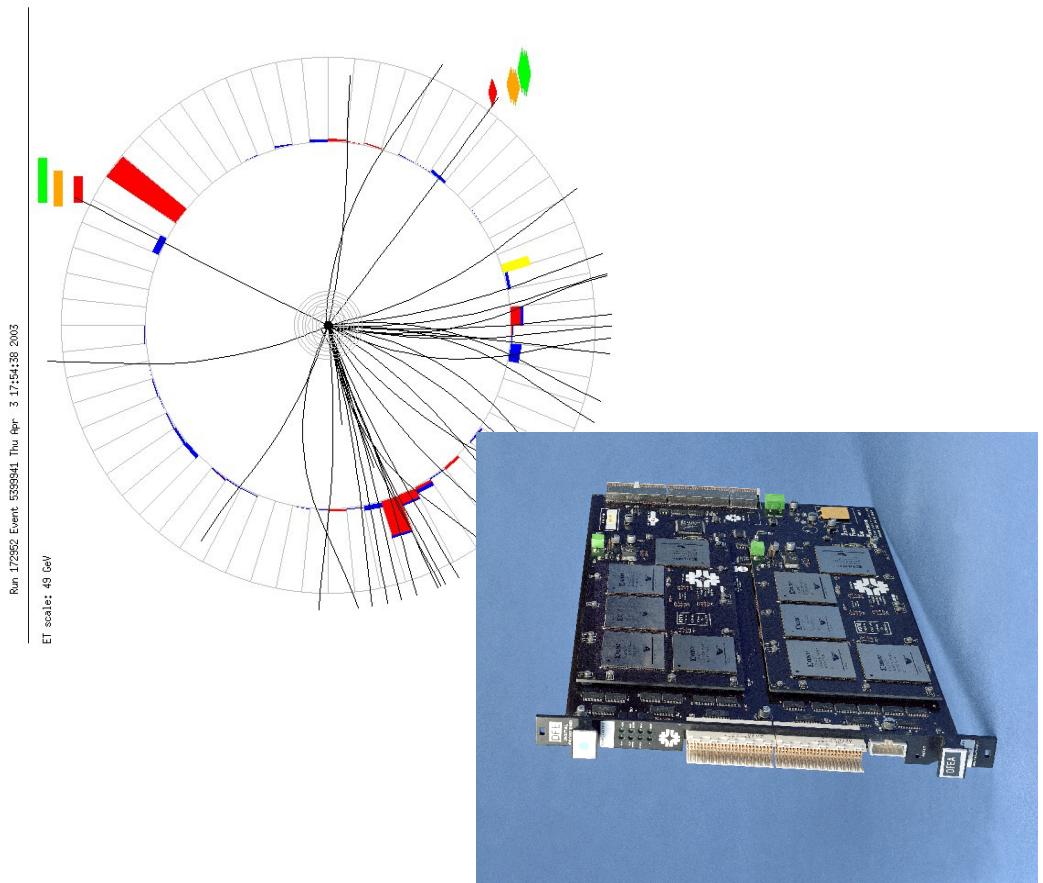


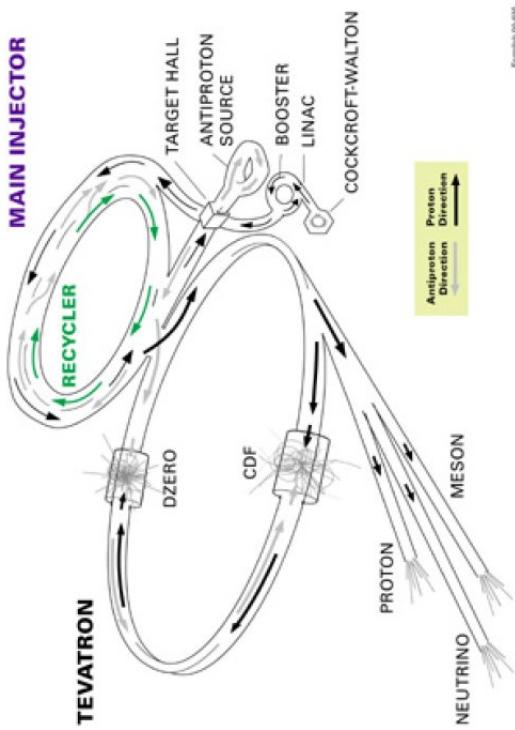
The Level 1 Central Track Trigger at D \emptyset

Satish Desai
SUNY Stony Brook



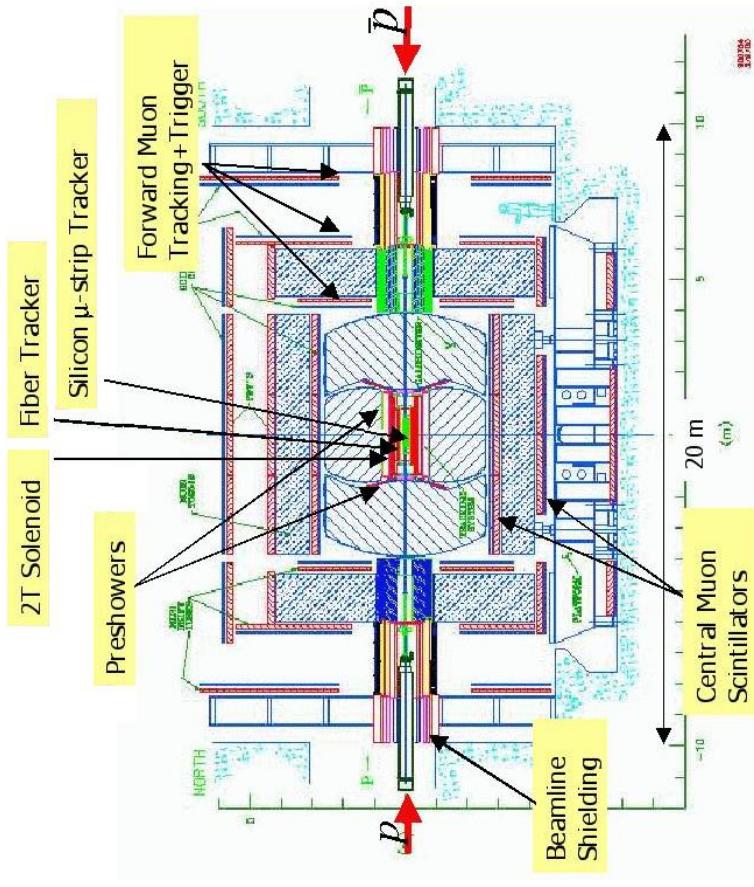
DØ in RunII

FERMILAB'S ACCELERATOR CHAIN



• The Tevatron RunII

- Higher Collision Energy of 1.96 TeV
- Higher Luminosity ($2\text{-}11 \text{ fb}^{-1}$)
- Collisions Every 396 ns



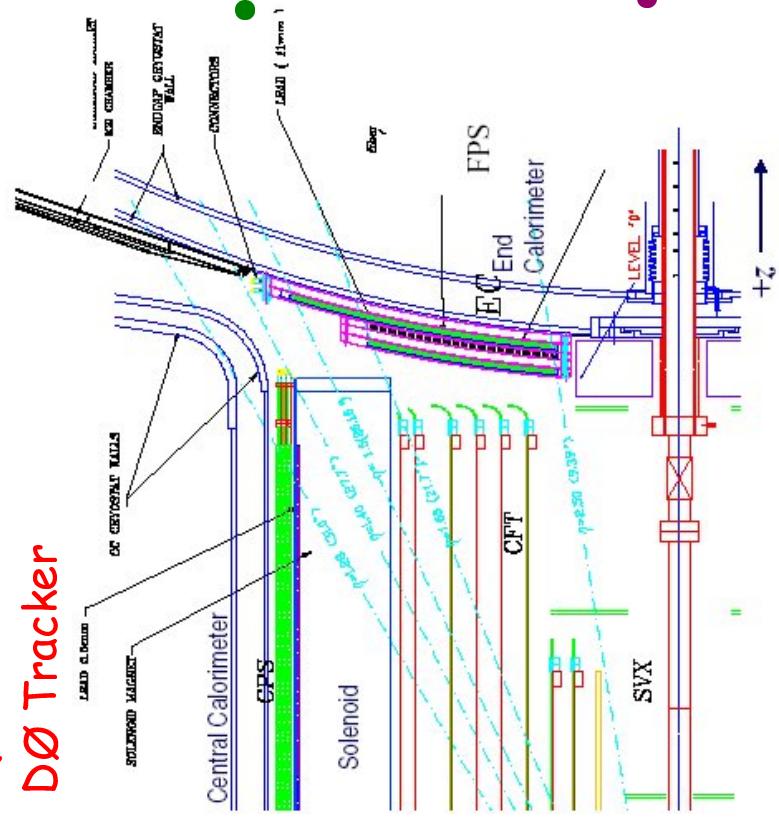
- **DØ in RunII**
- New Tracking System
- 2 T Magnetic Field
- New Forward Muon System
- New Readout Electronics
- New Trigger



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The DØ Tracking System

Quarter View of DØ Tracker



• Central Fiber Tracker (CFT)

- 77k Scintillating Fibers
- 8 Axial Layers in L1 Trigger
- 8 Stereo Layers not in L1 Trigger

• Preshowers (CPS/FPS)

- Central and Forward Coverage
- 23k Wavelength Shifting Fibers embedded in triangular Scintillator
- In L1 Trigger

• Silicon Microstrip Tracker (SMT)

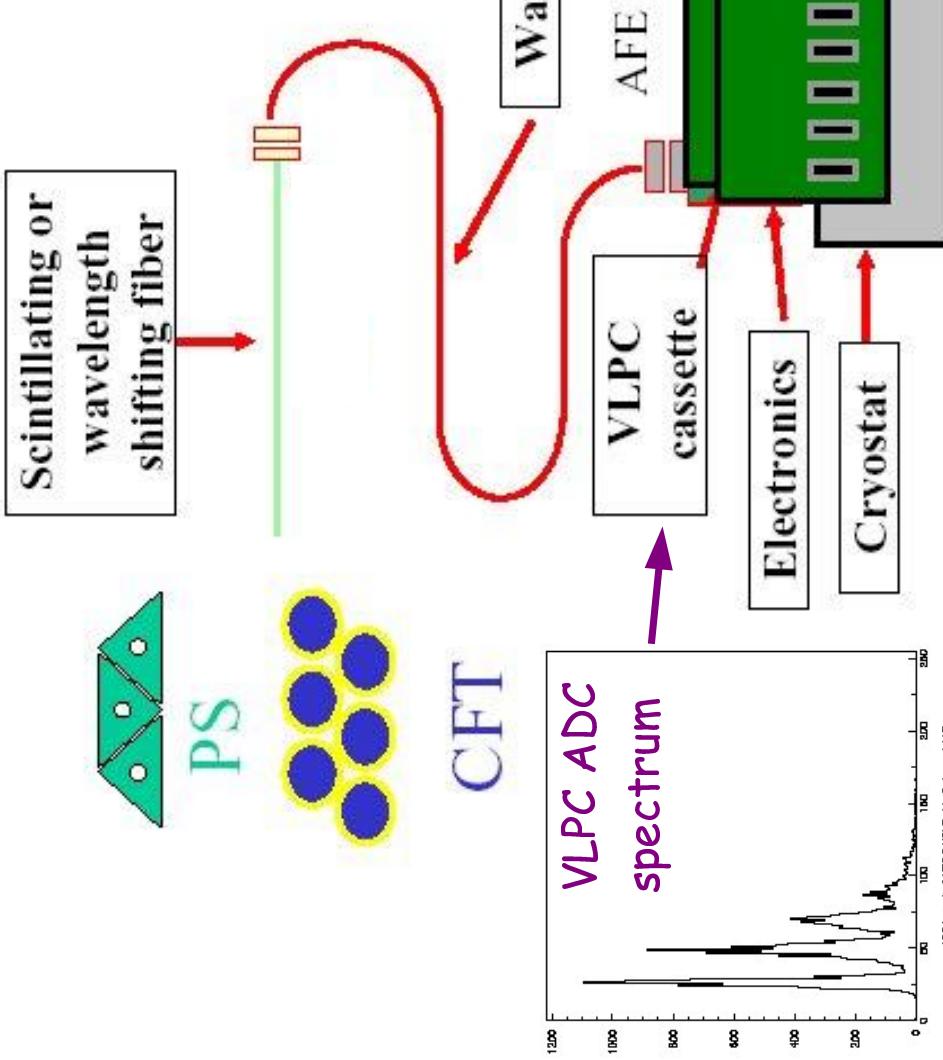
- 800k Channels
- Does Not Participate in L1 Trigger



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DØ Tracking Electronics

- Discriminator Signals sent to CTT for every event
 - Used to form Level 1 & 2 Decisions
 - Digitization and Readout occurs on Level 1 Accept



The Level 1 Central Track Trigger



- Need to Filter Collisions at 2.5 MHz to 50 Hz
- The Level 1 Central Track Trigger (CTT)
 - Identifies Tracks in 4 pT bins
 - Matches to Preshower Clusters
 - Flags Isolated Tracks
 - Calculates Occupancies
 - Feeds Level 1 Muon Trigger
 - Feeds Level 2 Trigger (b-tagging)
- Useful for Triggers Involving
 - Higgs Physics
 - Top Physics
 - Electroweak Physics
 - B Physics
 - New Phenomena Searches

2.5 MHz

Level 1
4.2 μ s

5-10 kHz

Level 2
100 μ s

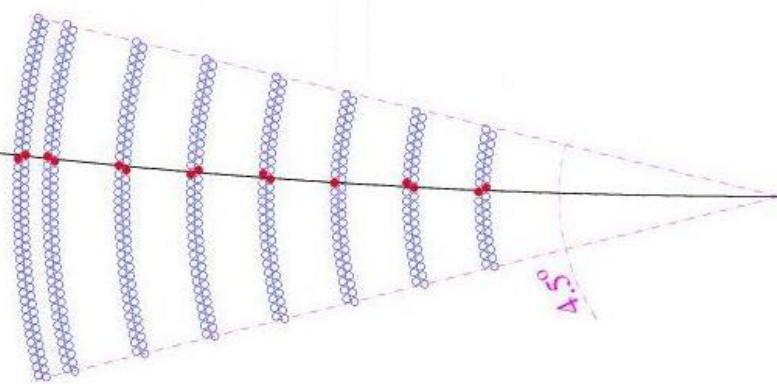
1 kHz

Level 3
25 ms

50 Hz



How it Works



- Hits Converted To Doublets (Clusters)
- Feed Doublets into Predefined Boolean Equations
 - Only $r-\varphi$ Information Used
 - Tracks Found in 4.5° Slices in φ (Sectors)
- Require 8 Doublets from 8 Detector Layers
- Further Stages Calculate Track Counts
 - In Octants
 - In Whole Fiber Tracker
- Algorithm Runs on FPGAs (Very Flexible)

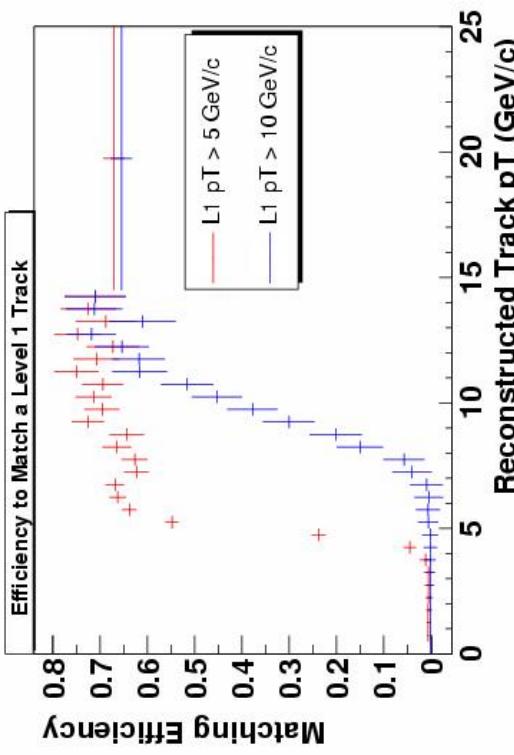
Hypothetical Track in a
CFT Trigger Sector

Track Finding
Board

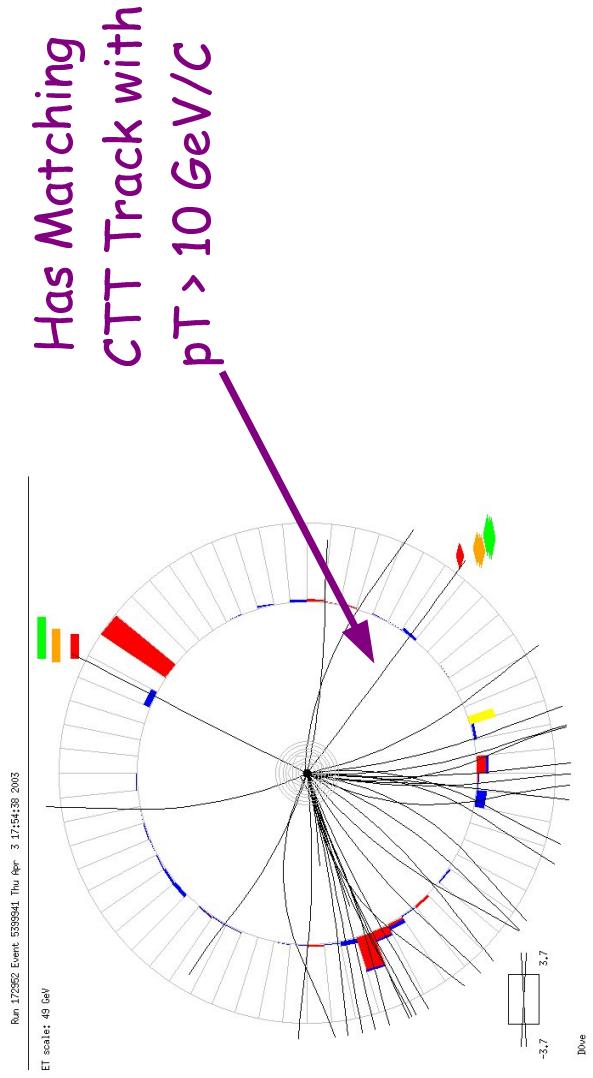


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Performance



- Recently Brought Online
- Match Offline Tracks in CFT to Tracks Found by CTT Readout
- Currently About 70% Efficient on the Plateau
- Still Lots of Places for Improvements



- Isolated Offline Tracks
 - 16 CFT Hits
 - Impact Parameter Cut
 - Vertex Position Cut
 - Vertex χ^2 Cut
 - Track pT Cut
- Look for CTT Tracks in ± 1 Sector

Conclusions

- The CTT Has Just Come Online and is Providing Simple Triggers
 - 1 or 2 Tracks Above Threshold
 - Muon System Track Matching
- Initial Studies Show They are Working
- Additional Triggers are Coming Online
 - Isolated Tracks
 - Occupancy
- Optimization of Performance Continues



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